

EXHIBIT A

PART 2 OF 3

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A layer of solder is present on the right of the solder ridges shown in Figure 14. This layer of solder would have been present between the brass valve fitting and the copper tube prior to their separation. The photomicrographs in Figure 15 show this layer of solder at a higher magnification. From these photomicrographs it can be seen that the solder remaining on the surface of the copper is approximately 200 μm thick.



Figure 9. Stereomicroscope image of Joint Section 1.

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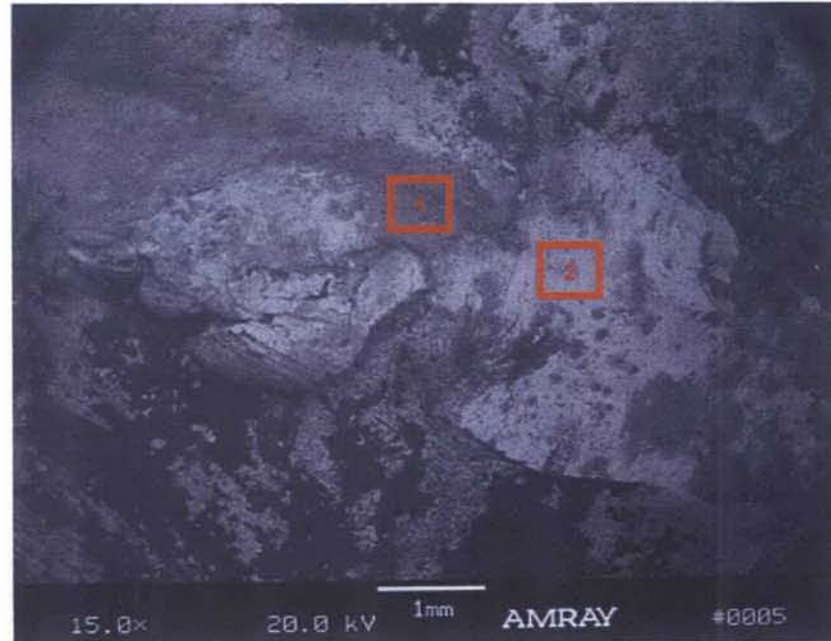


Figure 10. Backscattered SEM image of the ridge on Joint Section 1. EDS spectra acquired from the regions in the red boxes are shown in Figure 11 and Figure 12.

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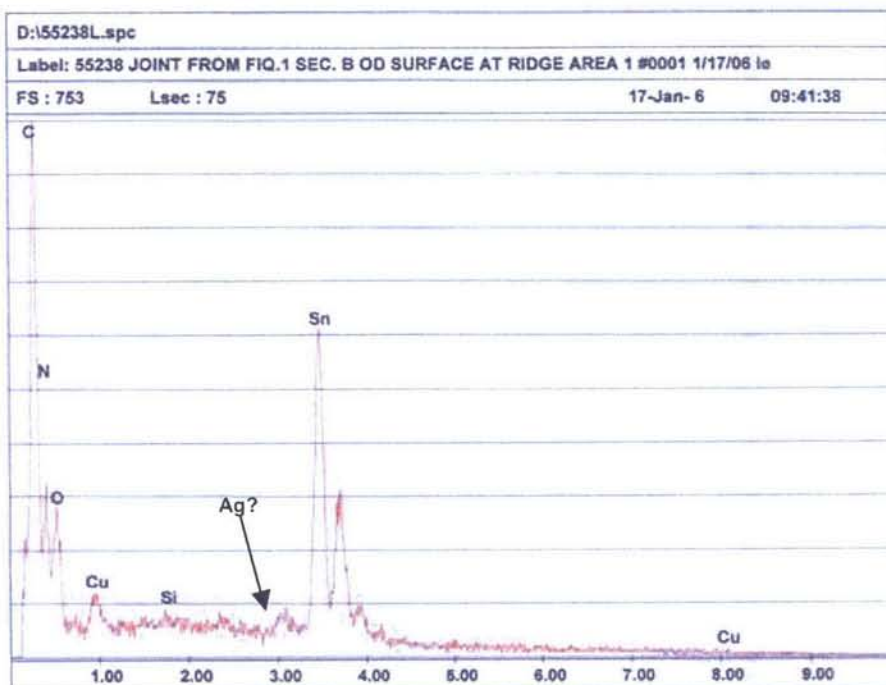


Figure 11. EDS spectra of the region inside red box #1 shown in Figure 10.

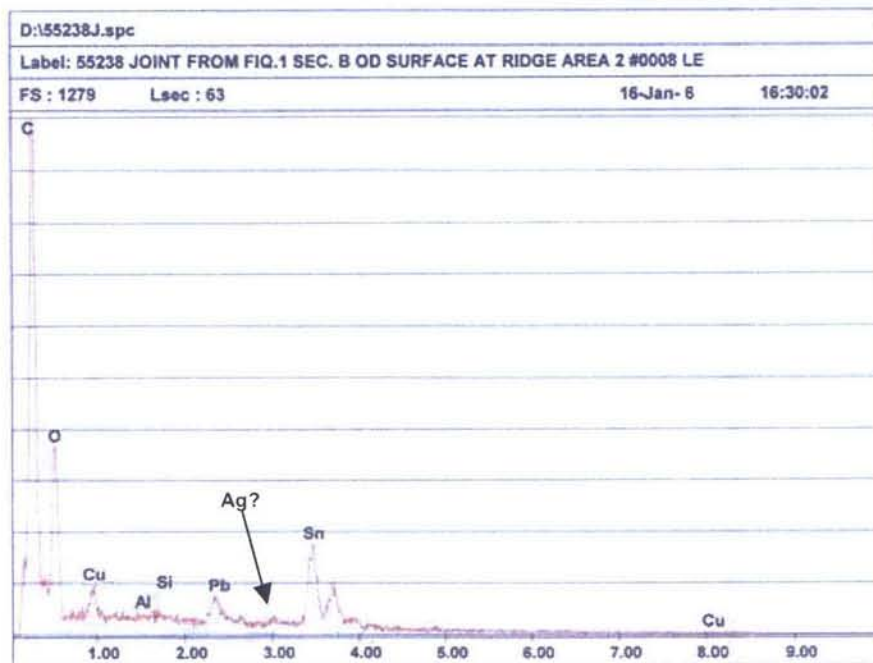


Figure 12. EDS spectra of the region inside red box #2 shown in Figure 10.

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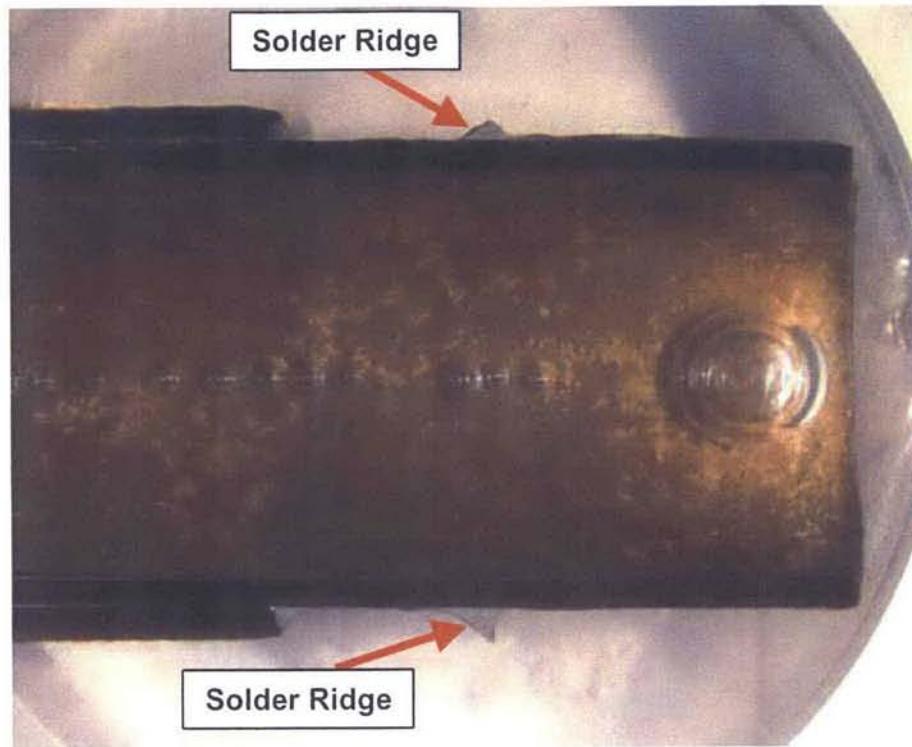


Figure 13. Stereomicroscope image of the polished cross-section of Joint Section 1.

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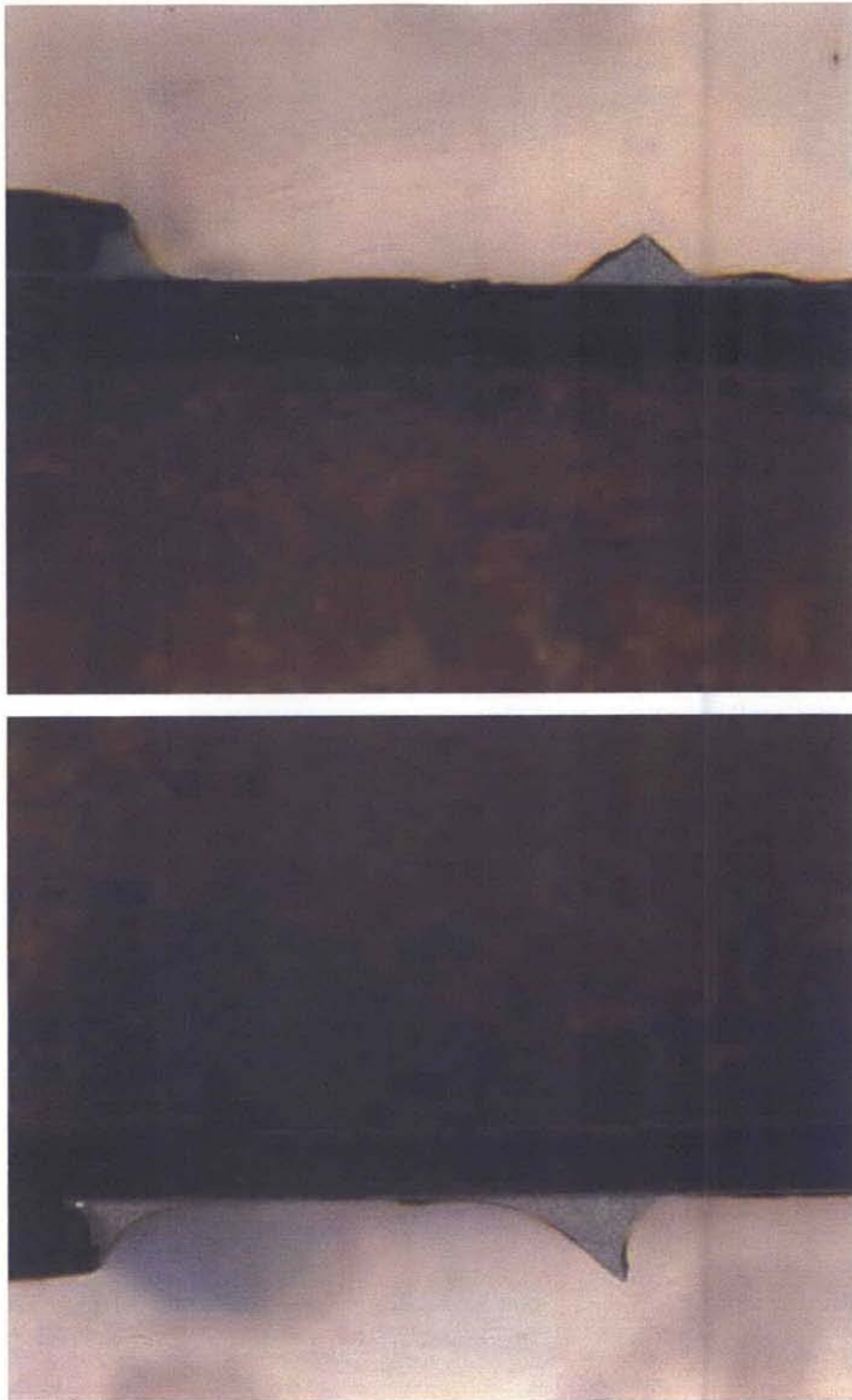


Figure 14. Stereomicroscope images of the polished cross-section of Joint Section 1 showing the solder ridge at higher magnification.

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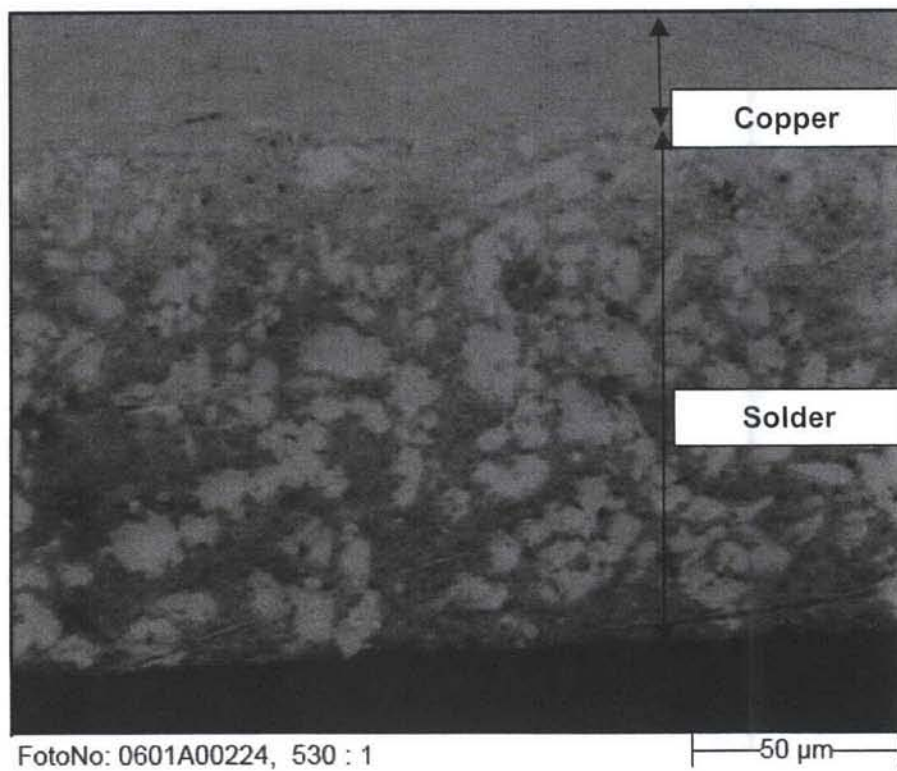
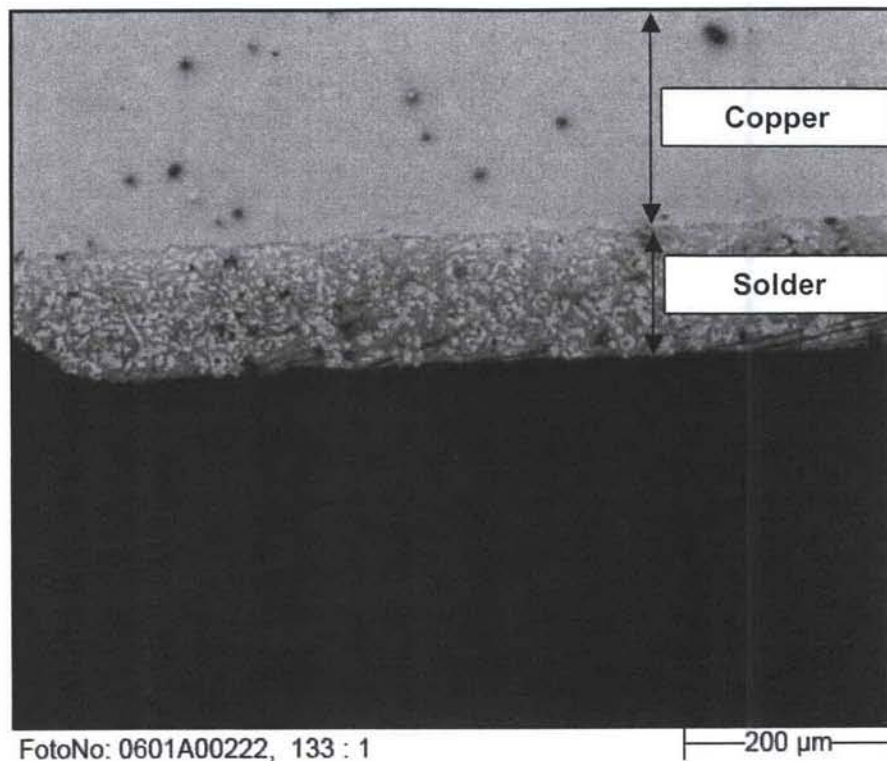


Figure 15. Optical photomicrographs showing the amount of solder remaining on the copper tube surface of Joint Section 1.

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Joint Section 2

Joint Section 2 refers to the female brass valve fitting that was soldered to Joint Section 1. A stereomicroscope image of Joint Section 2 is shown in Figure 16. An SEM image of the inner surface of Joint Section 2 is shown in Figure 17. The red box in this image denotes the region where EDS analysis was performed on this surface. The spectrum acquired from this EDS analysis is shown in Figure 18.

Similar to the corresponding surface of Joint Section 1, the EDS analysis shows the presence of carbon and oxygen on the surface. As with Joint Section 1, it is likely that this carbon and oxygen is a result of soot and oxides that accumulated on the surface during and after the fire. The metals detected include tin, copper, aluminum and lead. All of these elements except aluminum are present in the solder and/or the brass alloy. A discussion with the SEM operator at MMR revealed that the aluminum is likely an artifact of the aluminum sample holder and not the sample itself.

The female brass valve fitting was cut parallel to the axis of the tube and prepared metallographically so that the cross-section of the brass/solder interface could be investigated. An optical photomicrograph of this interface is shown in Figure 19. It should be noted that this photomicrograph was taken at the same magnification as the photomicrograph in the bottom of Figure 15. It is apparent from this photomicrograph that the amount of solder remaining on the surface of the brass is significantly less than that found on the corresponding copper tube.

A backscattered electron image of the same cross-sectioned sample is shown in Figure 20. As with the optical photomicrograph, it can be seen that the amount of solder remaining on the brass fitting is only $\sim 10\text{ }\mu\text{m}$, which is approximately 20 times less than that found on the copper tube. The bright regions in the brass cross-section are metallic lead that is present as part of the brass alloy. EDS analysis was conducted at the points denoted by the numbered arrows in this figure. The spectra acquired from this analysis are shown in Figure 21, Figure 22 and Figure 23.

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Figure 16. Stereomicroscope image of Joint Section 2.

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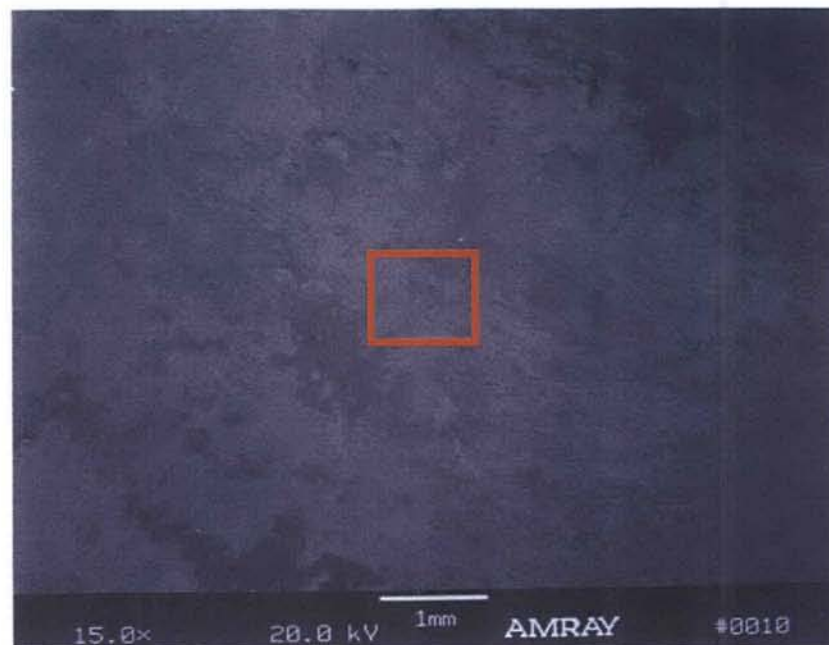


Figure 17. Backscattered SEM image of the inner surface of Joint Section 2. An EDS spectra of the region denoted by the red box is shown in Figure 18.

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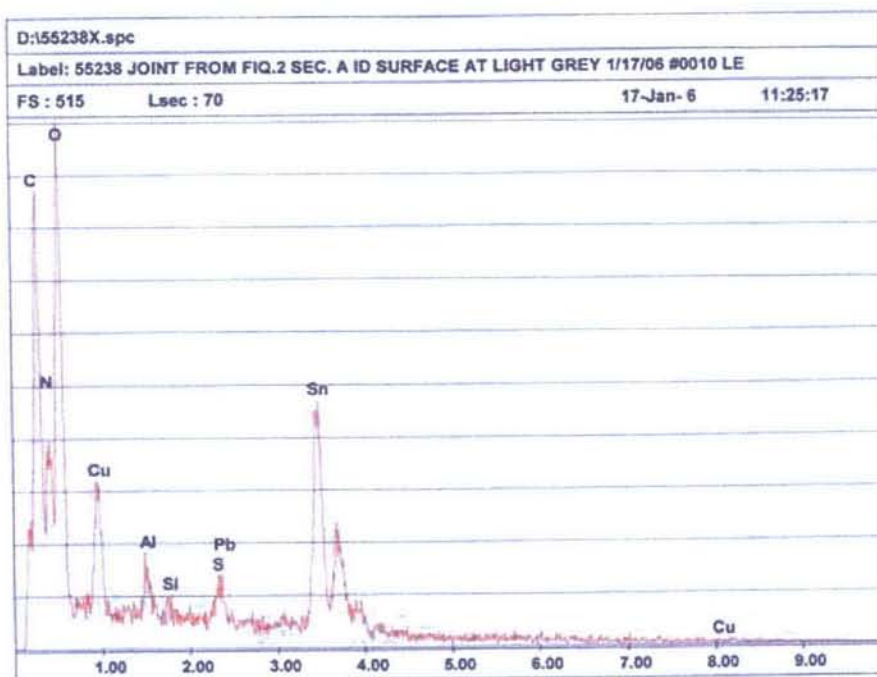


Figure 18. EDS spectra from the region denoted by the red box in Figure 17.

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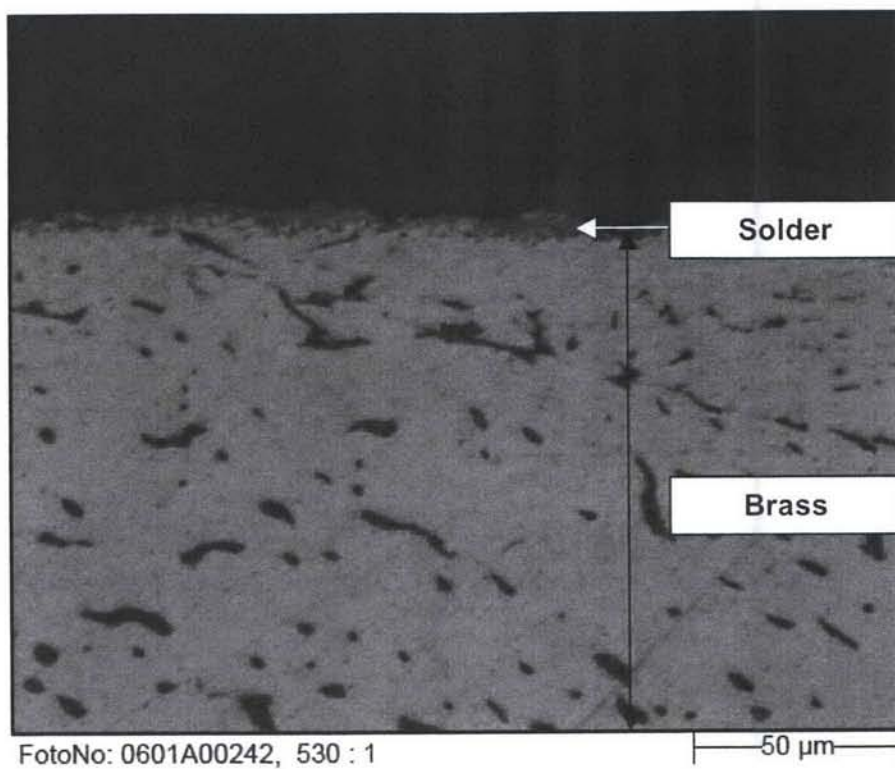


Figure 19. Optical photomicrograph showing a cross-section through the inner surface of Joint Section 2.

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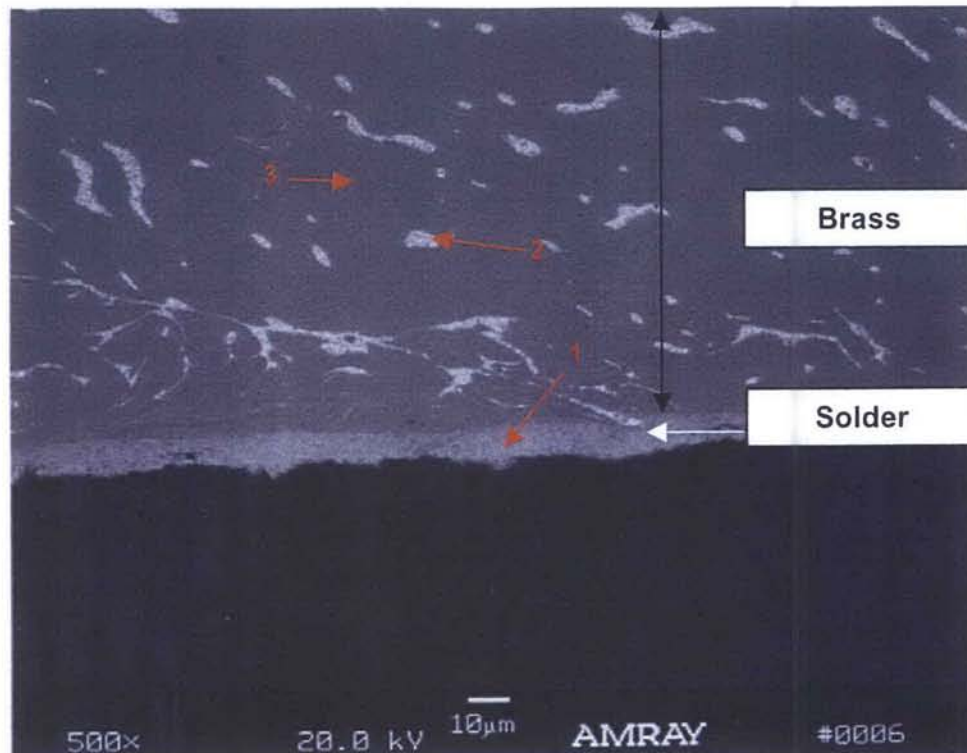


Figure 20. Backscattered SEM image showing the cross-section of the brass fitting from Joint Section 2. The red numbered arrows indicate areas where EDS spectra were acquired. These spectra are shown in Figure 21, Figure 22, and Figure 23.

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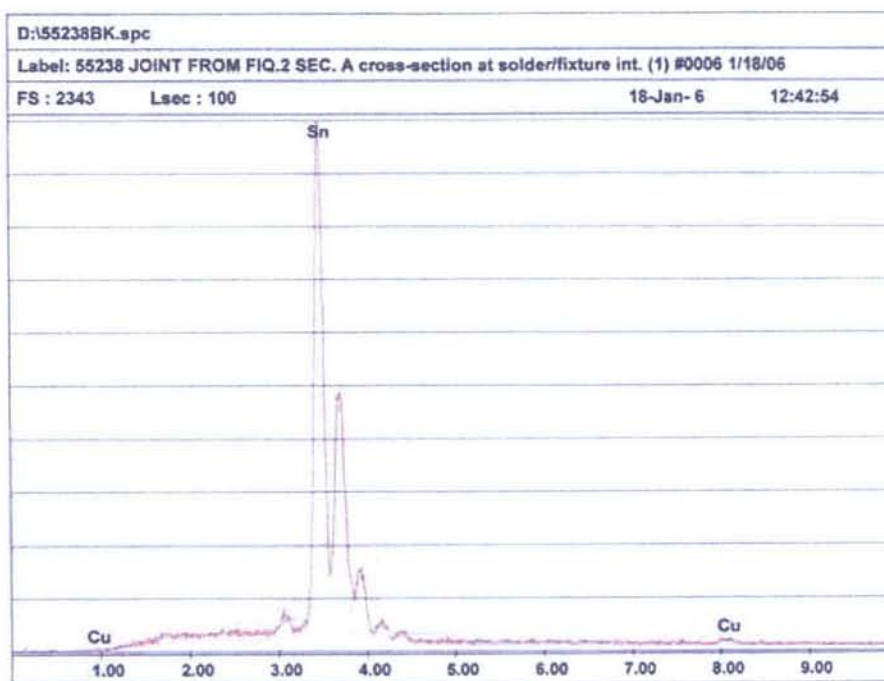


Figure 21. EDS spectra of the area denoted by arrow #1 in Figure 20.

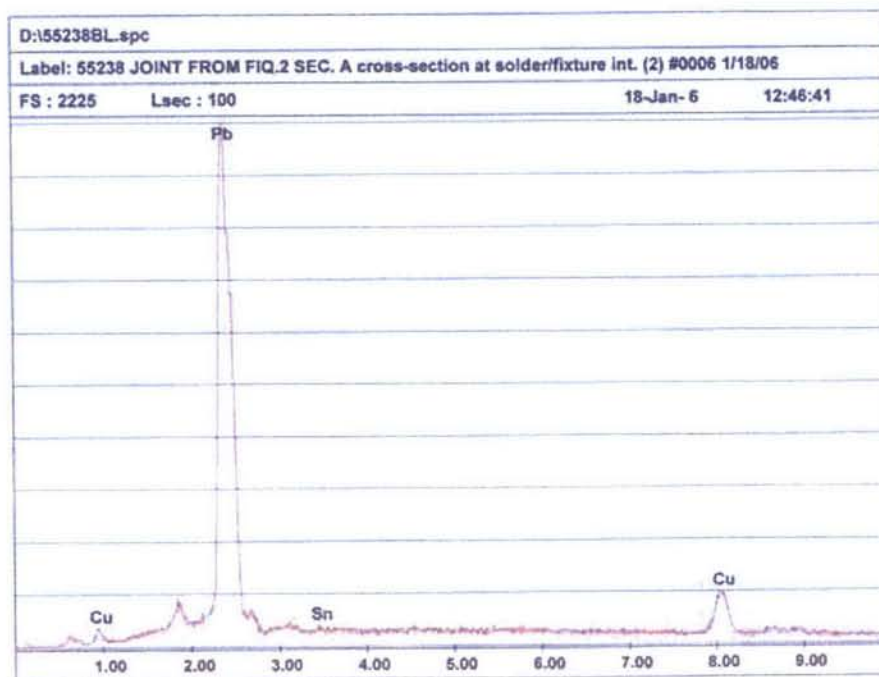


Figure 22. EDS spectra of the area denoted by arrow #2 in Figure 20.

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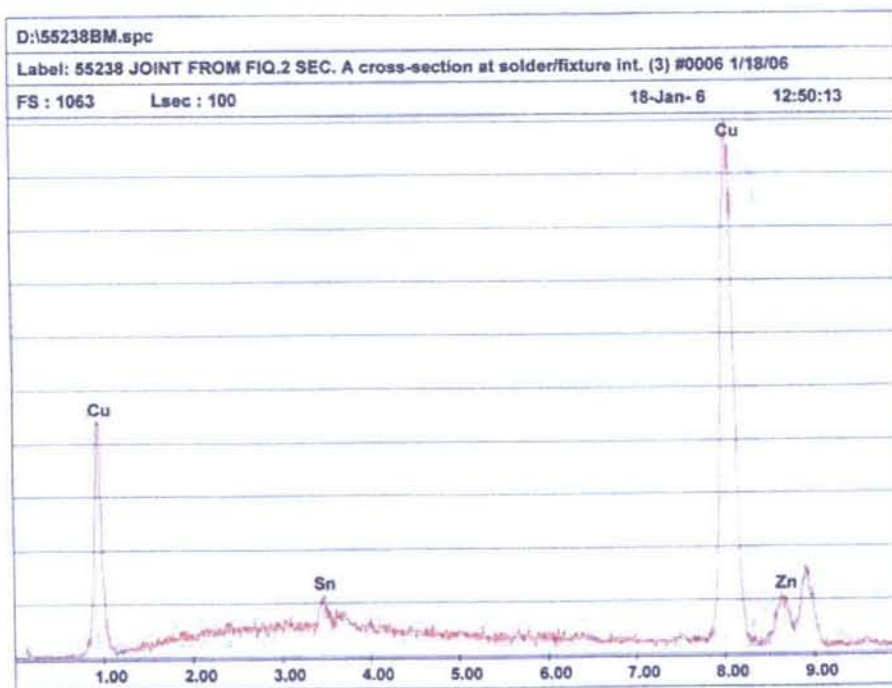


Figure 23. EDS spectra of the area denoted by arrow #3 in Figure 20.

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Joint Section 3

Joint Section 3 refers to the copper tube that was soldered to the female brass compression fitting. Stereomicroscope photos of Joint Section 3 are shown in Figure 24 and Figure 25. The prominent features on Joint Section 3 are the large deposits of solder residue on the outer surface of the tube. Unlike Joint Section 1, the solder on the surface of this section of the copper tube appears to have been molten at some point after the joint was separated. This section of tubing was also cross-sectioned and metallographically prepared to analyze the interface between the copper tubing and the solder. An optical photomicrograph of this interface is shown in Figure 26. The thickness of the solder deposit on the copper tube is ~200 μm , which is consistent with the thickness of the solder left on Joint Section 1.